APPENDIX I

Stormwater Analysis

Stormwater Analysis for the proposed Agua Hedionda South Shore Specific Plan for 85% Open Space and 15% Retail

City of Carlsbad, California

Prepared for:

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May 8, 2015

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Introduction

The Agua Hedionda South Shore Specific Plan for 85% Open Space and 15% Retail (Agua Hedionda 85/15 Specific Plan or Specific Plan) is comprised of approximately 203.4 acres of land between the south shore of the Agua Hedionda Lagoon and Cannon Road in the City of Carlsbad, California. The Specific Plan will permanently protect and conserve approximately 176.7 acres for open space, the continuation of strawberry farming and coastal agricultural (more than 85% of the Specific Plan area), and will reserve approximately 26.7 acres (less than 15% of the Specific Plan area) for a new pedestrian-friendly visitor serving outdoor retail, shopping, dining and entertainment promenade, all at no tax burden to the residents of Carlsbad. The Specific Plan requires that the open space lands be improved with low impact public access by providing passive recreation amenities including miles of new nature trails and walkways, picnic and rest areas, lagoon vistas, an outdoor classroom, parking and an integrated resource and educational signage program. The Outdoor Shopping, Dining and Entertainment Promenade, together with supporting uses including a farm-to-table restaurant and farm stand will provide for a total of approximately 585,000 square feet of visitor serving uses within the Specific Plan. The implementation of the Specific Plan is anticipated to occur between 2017 and 2019. This report has been prepared consistent with the Specific Plan.

This memorandum summarizes the findings and recommendations relating to storm water mitigation necessary for the proposed Visitor Serving Commercial (VSC) land uses on approximately 27 acres in the western portion of the Specific Plan area. In particular, this study investigated measures needed for peak flow attenuation, water quality, and hydromodification for the proposed VSC portions of the Specific Plan area.

Hydrology

The site drains in northerly direction towards Agua Hedionda Lagoon. Some offsite developed areas including Cannon Road and surrounding commercial businesses drain their runoff through the site via basins which appear to be designed for water quality treatment of these offsite runoff. Both existing and proposed hydrologic models prepared for this study included this assumed offsite area. The western drainage limits were defined by watershed information provided by Dudek.

For the hydrologic analysis, the Specific Plan area was subdivided into seven sub-watershed areas determined by designated outlet points into the Agua Hedionda Lagoon. See attached Hydrology Exhibits. As shown on the hydrology exhibits, it is evident that only two of the delineated sub-watershed areas would be impacted by the proposed development. That is, development within two of the sub-watershed areas would either divert, increase, or alter stormwater runoff in some form compared to its existing condition. Refer to sub-watershed areas with node series numbers 500 and 700 on the hydrology exhibits. Further references to these two sub-watersheds within this memo will be labeled as Watershed 5 and Watershed 7, respectively.

Both of the impacted sub-watersheds introduced impervious areas with the proposed development and consequently increased their stormwater runoff. In order to offset this increase, peak flow attenuation measures will be needed for these two sub-watersheds. Watershed 5 was analyzed with the use of a detention basin to reduce its runoff rates to below existing condition. Watershed 7 was also analyzed with a detention basin but was also separately analyzed with the use of an underground vault due to the site's potential limitation to allow for adequate above ground storage volume capacity. The basin or hydromodification vault will outlet into Agua Hedionda Lagoon via a 36" reinforced concrete pipe and concrete headwall. A 110 square foot rip rap energy dissipator placed immediately downstream of the headwall will serve to reduce outlet velocities below erosive levels prior to emptying into the lagoon. See Figure A at the end of this study for a plan view of the outlet pipe.

The Results section below summarizes the findings of the hydrologic analysis. For both Watersheds 5 and 7, water quality and hydromodification impacts were considered concurrently with the detention basin design as will be described in the Water Quality & Hydromodification section below.

Water Quality & Hydromodification

As mentioned in the previous section, only two of the seven delineated sub-watersheds are impacted by the proposed development which will include the commercial areas, parking lots, and associated access roads. Due to the related increases to the site's imperviousness and runoff, the project, specifically Watersheds 5 and 7, will need to provide stormwater treatment for water quality and hydromodification in order to meet the City of Carlsbad's Standard Urban Stormwater Management Plan (SUSMP) requirements for new developments. The Environmental Protection Features (EPF) section below summarizes the Specific Plan's mitigation measures.

Watershed 5 consists of a portion of the access road with entrance at the intersection of Cannon Road and Car Country Drive. Treatment for this 3.4 acres of developed area is proposed to be addressed by a biofiltration basin adequately sized for both water quality volume and hydromodification. Per the 2013 San Diego permit mentioned above, the basin has been sized with a capacity to treat 1.5 times the design capture volume. To address hydromodification, the EPA's Storm Water Management Model (SWMM) program was used to generate a continuous simulation hydrologic model for the sub-watershed and verify that that post-project discharge rates and durations were not exceeded in accordance with the City's SUSMP requirements. The model included routing the storm through the proposed biofiltration basin as well as accounting for water quality volume. The table in the Results section below summarizes the basin configuration for the Watershed 5.

A similar analysis was prepared for the Watershed 7 as for Watershed 5. However, an additional alternative was prepared for treatment of this sub-watershed. Due to potential open space constraints of the first alternative consisting of an above-ground basin, the second alternative investigated the requirements needed for a separating the water quality and hydromodification systems. In this case, above ground bioretention areas would serve for water quality while an underground vault would be installed to meet hydromodification/detention needs. The bioretention areas would be placed throughout the site and provide treatment on a more localized scale as opposed to the regional approach of a basin. The results of both alternatives for Watershed 7 are included in the Results section below.

Environmental Protection Features

Hydrology
EPF HYD-1 A biofiltration basin shall be implemented on site within subwatershed 5 for detention of peak flows from the access road on site.
EPF HYD-2 One of two detention options shall be implemented on site within subwatershed 7 to attenuate peak flows associated with on-site construction. A biofiltration basin shall be implemented to detain flows above the surface if no potential open space site constraints are encountered during final design. If these constraints occur, an underground detention vault shall be implemented.
EPF HYD-3 The Specific Plan applicant shall be responsible for ensuring that all final design plans (e.g., grading plans, improvement plans, landscape plans, building plans) incorporate all source control, site design, and treatment control best management practices (BMPs); hydromodification features, and Low Impact Development facilities.
EPF HYD-4 The Specific Plan applicant shall prepare and submit its stormwater management plan for review by the city engineer, in accordance with the exclusive provisions set forth in Chapter 6.4, Specific Plan Procedures and Process, of the Specific Plan, demonstrating how the Specific Plan complies with hydromodification requirements per the City's Standard Urban Stormwater Management Plan (latest version).
EPF HYD-5 NOT USED.
EPF HYD-6 NOT USED.
EPF HYD-7 The Specific Plan applicant shall prepare and process improvement plans for review by the city engineer.
EPF HYD-8 NOT USED.
EPF HYD-9 The Specific Plan applicant, on behalf of itself and all of its successors in interest, has hereby agreed to hold harmless and indemnify the City of Carlsbad from any action that may arise through any diversion of waters, the alteration of the normal flow of surface waters or drainage, or the concentration of surface waters or drainage from the drainage system or other improvements identified in the City-approved development plans; or by the design, construction, or maintenance of the drainage system or other improvements identified in the City-approved construction plans.
EPF HYD-10 NOT USED.
EPF HYD-11 The Specific Plan applicant shall implement the following Hydromodification Control Performance Standard: Hydromodification control BMPs shall be selected and applied to maintain post-project flow rates and durations within 10% of pre-development conditions, for the range of geomorphically significant flows. In addition, construction in the Specific Plan area will avoid critical sediment yield areas as identified in the Carlsbad Watershed Management Area Analysis, or implement measures that allow critical coarse sediment to be discharged to receiving waters, such that there is no net effect to the receiving water. The hydromodification performance standard shall be achieved through LID and/or hydromodification control BMPs designed to achieve the flow duration control standard. Hydromodification control BMPs that shall be implemented to meet the performance standard may include the LID site design and structural BMPs for water quality. Alternatively, hydromodification control may be provided in separate stand-alone flow control facilities or in combination with flood control.

Stormwater Results

The following preliminary results summarize the facilities needed to achieve adequate stormwater treatment for development of the Specific Plan area. As described above, the westernmost sub-watershed provided an alternate scenario to account for an underground vault in place of basin for use for peak flow attenuation and hydromodification.

	Sub-Watershed Series			
Watershed I.D.	5	7		
Area	48.9	55.0		
Existing Q100	102.66 cfs	68.88 cfs		
Proposed Q100 w/o Detention	106.51 cfs	134.84 cfs		
Treatment Measure	Basin	Basin	Vault / Bioretention Area	
Proposed Q100 w/ Detention	101.87 cfs	49.70 cfs	41.94 cfs	N/A
Sizing Requirements			Vault	Bioretention
Bottom surface Area :	2,078 sf	22,000 sf	25,000 sf	1.3 acre*
Basin Depth:	5 ft	9 ft	11.33 ft	0.5 ft
Engineered Soil layer depth:	1.5 ft	1.5 ft	N/A	1.5 ft
Gravel Layer Depth:	1.5 ft	2.5 ft	N/A	2.0 ft

*-Based on 4% rule and storage capacity for 1.5 times the Water Quality volume.

References

"San Diego County Hydrology Manual", County of San Diego Department of Public Works – Flood Control Section; June 2003.

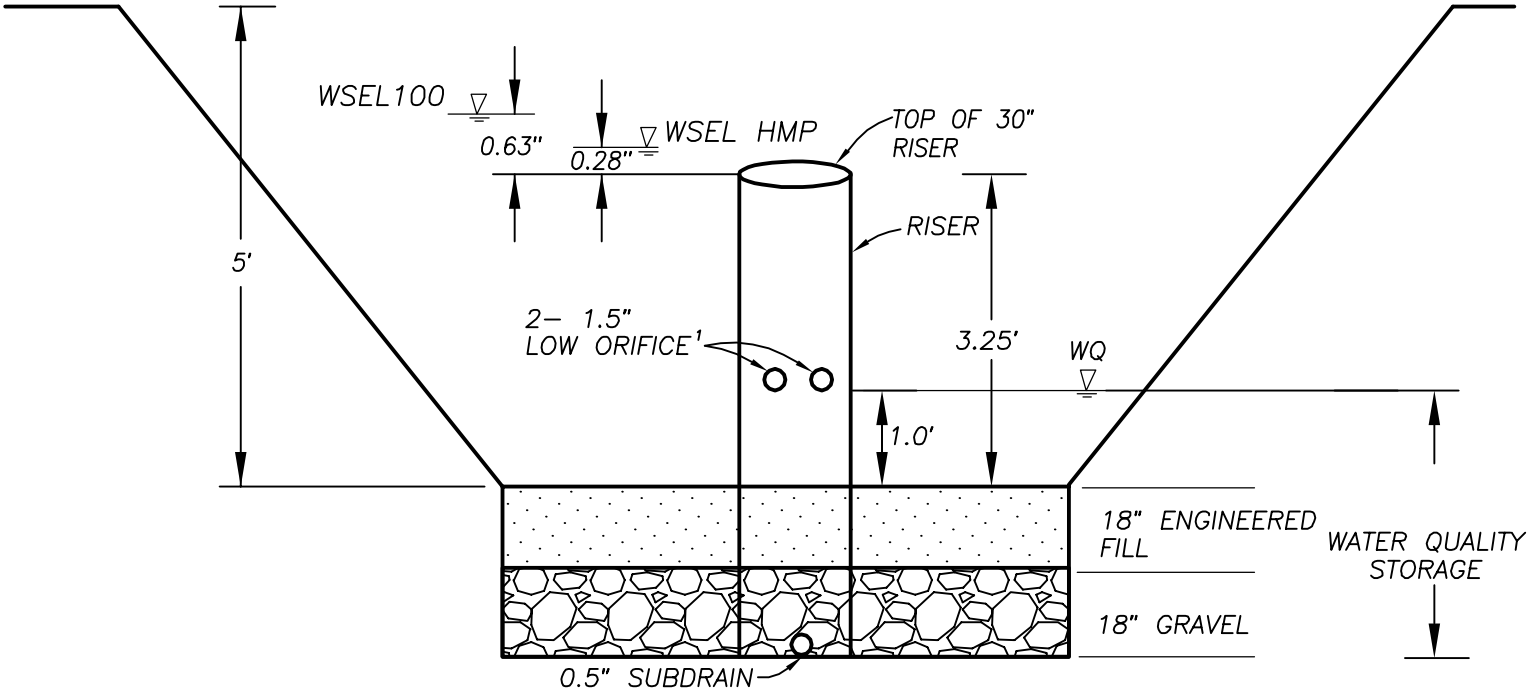
"Water Quality Plan for the San Diego Basin", California Regional Water Quality Control Board - San Diego Region, September 8, 1994.

"*City of Carlsbad Engineering Standards*", City of Carlsbad; 2004 Edition.

"*City of Carlsbad Standard Urban Storm Water Mitigation Plan*", City of Carlsbad; April 2003.

SPECIFIC PLAN AREA:
BMP FACILITIES

POC1, WATERSHED 5:
BASIN 1 WQ/HMP FOR ACCESS ROAD & PEAK FLOW DETENTION



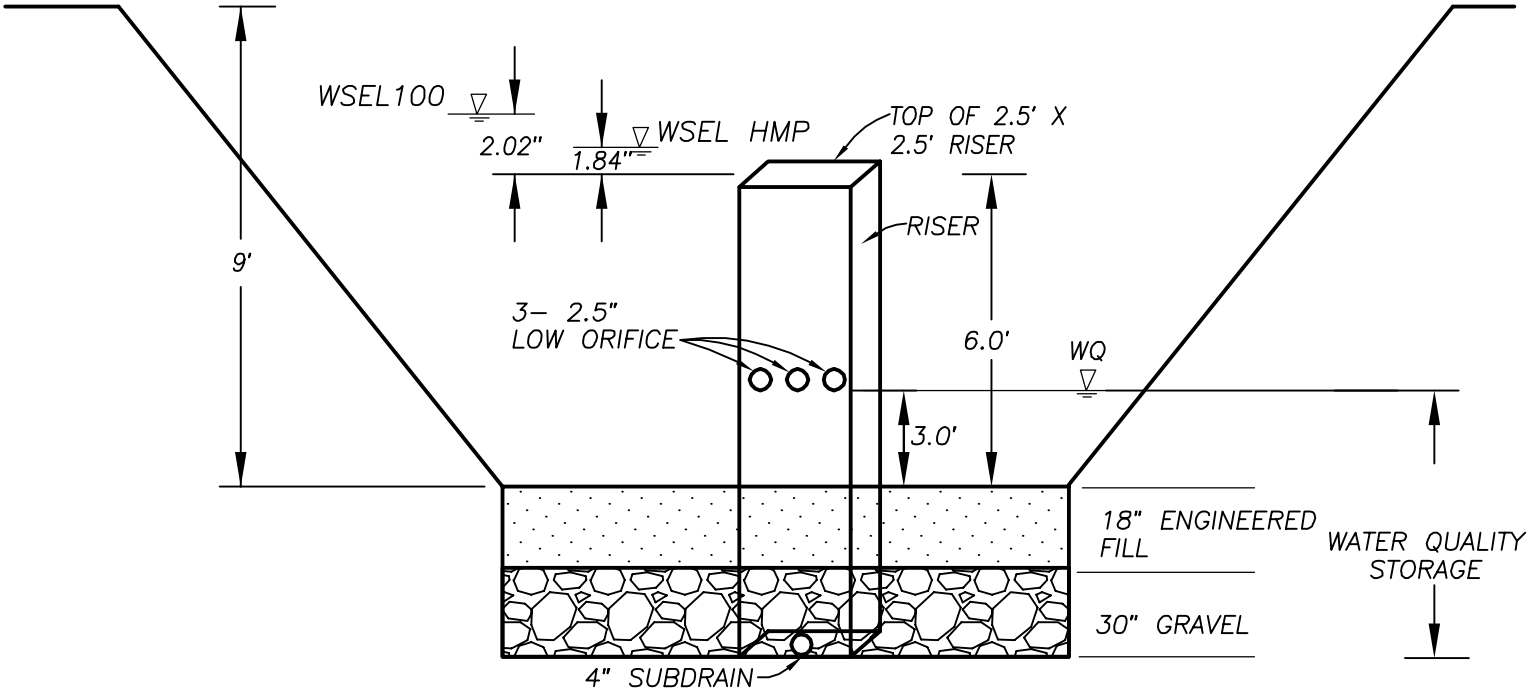
BOTTOM SURFACE AREA = 2,078 SF

TOP AREA AT 5' = 4,301 SF

BIOFILTRATION BASIN

NTS

POC2, WATERSHED 7:
BASIN 2 WQ/HMP FOR MAIN DEVELOPMENT & PEAK FLOW DETENTION



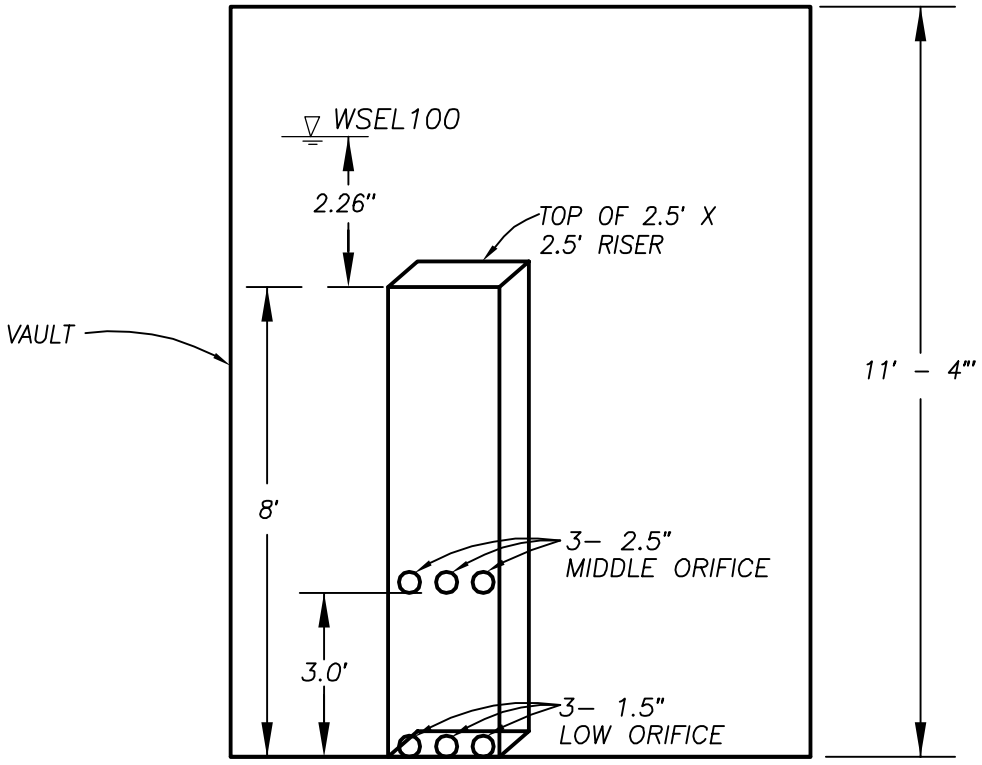
BOTTOM SURFACE AREA = 22,000 SF

TOP AREA AT 9' = 33,975 SF

BIOFILTRATION BASIN

NTS

POC2, WATERSHED 7:
VAULT : HMP FOR MAIN DEVELOPMENT & PEAK FLOW DETENTION



BOTTOM SURFACE AREA = 25,000 SF

HMP- DETENTION VAULT

NTS

WATER QUALITY REQUIREMENTS FOR ONSITE TREATMENT FOR THIS SCENARIO WILL BE BASED ON 2013 PERMIT VOLUME REQUIREMENTS AND CONSIDERATION OF 4% (SURFACE AREA) RULE:

BIORETENTION AREA BOTTOM SURFACE AREA = 1.3 ACRES
ALLOWABLE PONDING DEPTH: 6"

SPECIFIC PLAN AREA:
HYDROLOGY EXHIBITS

LEGEND

PROJECT BOUNDARY

DRAINAGE BOUNDARY

INITIAL SUBAREA

FLOW DIRECTION

NODE # (#)

SUBAREA ACREAGE # ACRES

EXISTING
Q100 = 55.79 CFS
AREA = 44.9 AC

EXISTING
Q100 = 20.77 CFS
AREA = 20.5 AC

EXISTING
Q100 = 65.47 CFS
AREA = 34.1 AC

EXISTING
Q100 = 12.56 CFS
AREA = 10.6 AC

EXISTING
Q100 = 102.66 CFS
AREA = 48.9 AC

EXISTING
Q100 = 11.32 CFS
AREA = 11.0 AC

EXISTING
Q100 = 68.88 CFS
AREA = 55.0 AC

44.66 ACRES
0.24 ACRES
0.25 ACRES
20.27 ACRES
7.75 ACRES
0.19 ACRES
17.02 ACRES
10.36 ACRES
2.87 ACRES
8.53 ACRES
0.16 ACRES
6.24 ACRES
10.91 ACRES
24.48 ACRES
0.25 ACRES
0.07 ACRES
15.69 ACRES
54.64 ACRES
0.33 ACRES

200 0 200 400 600
SCALE 1"= 200'

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EXISTING CONDITION HYDROLOGY EXHIBIT FOR:

Proposed Agua Hedionda South Shore Specific Plan for 85% Open Space and 15% Retail

CITY OF CARLSBAD, CALIFORNIA

SHEET 1 OF 2

W.O.# 3253-0001

LEGEND

PROJECT BOUNDARY

DRAINAGE BOUNDARY

INITIAL SUBAREA

FLOW DIRECTION

NODE #

SUBAREA ACREAGE — # ACRES

PROPOSED
Q100 = 55.79 CFS
AREA = 44.9 AC

44.66 ACRES

PROPOSED
Q100 = 20.77 CFS
AREA = 20.5 AC

0.24 ACRES

0.25 ACRES

PROPOSED
Q100 = 65.47 CFS
AREA = 34.1 AC

20.27 ACRES

7.75 ACRES

0.19 ACRES

PROPOSED
Q100 = 12.56 CFS
AREA = 10.6 AC

EXISTING
Q100 = 102.66 CFS
PROPOSED W/O DETENTION:
Q100 = 106.51 CFS
AREA = 48.9 AC
PROPOSED W/ DETENTION:
Q100 = 101.87 CFS

17.02 ACRES

10.36 ACRES

2.87 ACRES

PROPOSED
Q100 = 11.32 CFS
AREA = 11.0 AC

8.53 ACRES

0.16 ACRES

6.24 ACRES

EXISTING
Q100 = 68.88 CFS
PROPOSED W/O DETENTION:
Q100 = 134.84 CFS
AREA = 55.0 AC
PROPOSED W/ DETENTION:
Q100 = 49.70 CFS

3.12 ACRES

10.91 ACRES

19.18 ACRES

0.25 ACRES

1.94 ACRES

3.25 ACRES

15.69 ACRES

0.07 ACRES

6.39 ACRES

0.11 ACRES

0.24 ACRES

0.12 ACRES

28.43 ACRES

6.99 ACRES

9.55 ACRES

0.15 ACRES

200 0 200 400 600
SCALE 1"= 200'

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PROPOSED CONDITION HYDROLOGY EXHIBIT FOR:

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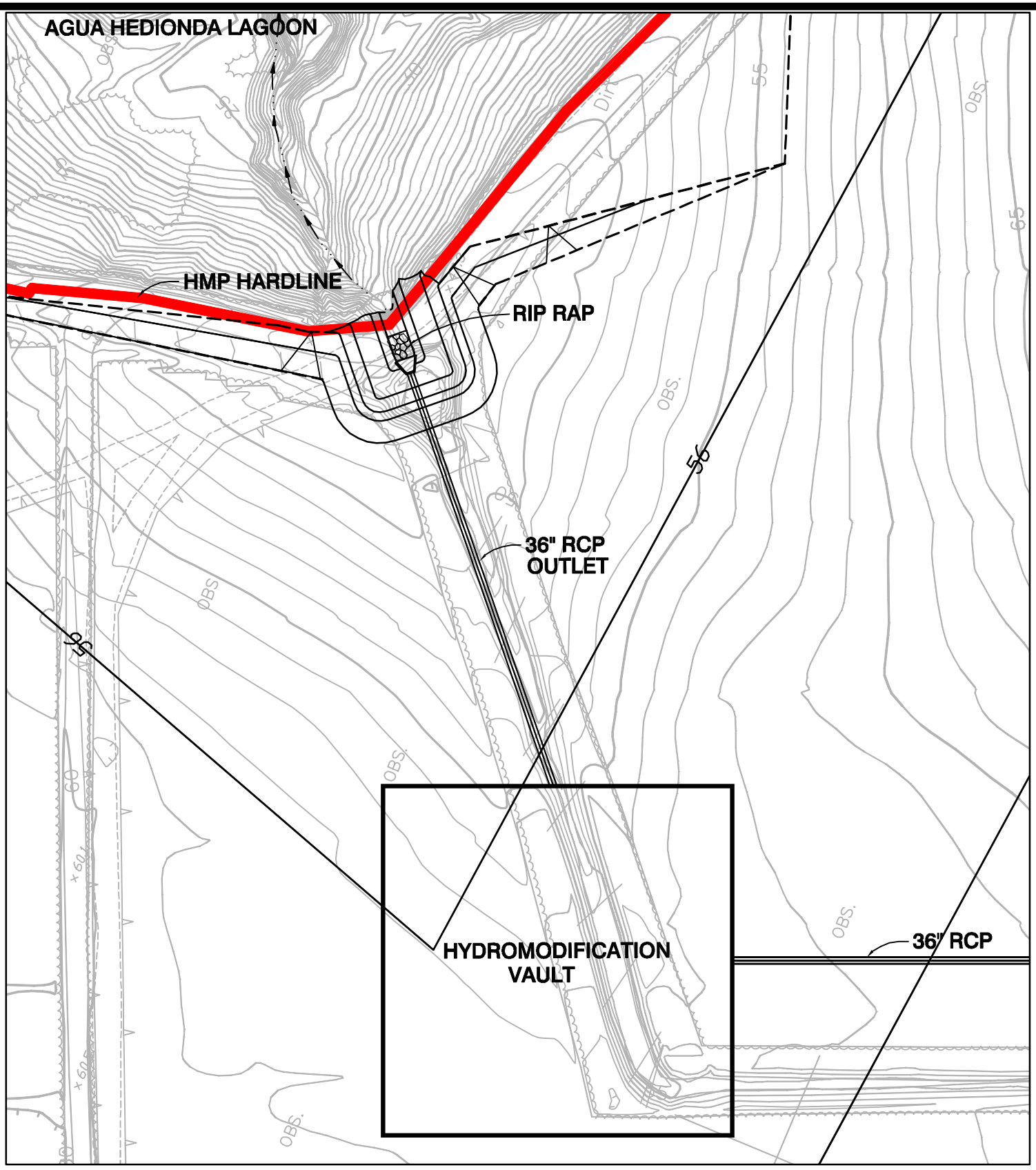
SHEET 2 OF 2

W.O.# 3253-001

SPECIFIC PLAN :
STORM DRAIN OUTLET
(FIGURE A)



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STORM DRAIN OUTLET

AGUA HEDIONDA SOUTH
SHORE SPECIFIC PLAN FOR
85% OPEN SPACE AND 15% RETAIL

CITY OF CARLSBAD, CALIFORNIA

FIGURE
A